Title
RESPONSE OF TWO CANOLA VARIETIES (Brassica napus L.) TO NITROGEN FERTILIZER LEVELS AND ZINC FOLIAR APPLICATION

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Publication Date
2009-05-20

Peer reviewed

Introduction

In Egypt, one of the most important problems in the agricultural sector is the shortage of oil production. This shortage is approximately 90 percent of the oil consumption, and covered by imports from abroad.

Canola (*Brassica napus*) is one of the most promising oil crops, characterized with high seed oil content of 40-45 percent. The cultivated area of canola in Egypt is relatively small due to the strong competition between canola and other strategic winter season crops on the limited arable land in Nile valley and Delta. Canola oil is a nutritionally highly valuable complement of human nutrition because of its low content of saturated fatty acids and high content of polyunsaturated fatty acids (Barth, 2007).

Nitrogen fertilizer is the most important element for crop growth and high yield with good quality. Seed yield and yield attributes increase by increasing nitrogen levels (Banga et al., 2007), while numerous studies report that increasing nitrogen levels decreases seed oil content (Sahoo et al., 2000).

Zinc is an essential micronutrient for plants, and is required for activity of various types of enzymes, carbohydrate metabolism, and protein synthesis. In Egypt, zinc deficiency is a widespread micronutrient deficiency as a result of the alkaline soil condition, so, it is very important to apply zinc fertilizer for increasing crop yields and quality.

Materials and Methods

Two filed experiments were conducted at the Experimental Station, National Research Centre, Kalubia Governorate, Egypt, during the two successive winter seasons of 2005-2006 and 2006-2007, to study the response of some canola varieties to nitrogen fertilizer levels and number of zinc foliar application. Soil texture was heavy clay, with clay 65%, silt 33% , sand 2% , pH 7.54 , organic matter 2.57% , EC 1.66 mmhos/cm^2 , N= 0.63, P= 0.27 and K= 2.4 available %. Split plot in randomized complete block design (RCBD) with three replicates was used with the canola cultivars (Topas and Pactol cvs.) allocated in the main plot while the nitrogen levels (20, 40 and 60 kg N/faddan) (faddan = 4200 m^2) and zinc foliar application treatments (one application or two applications) were randomly distributed in the subplot. The experimental unit area was 10.5 m^2 consisting of ten rows (3.5 m long and 30 cm between rows). Canola seeds were sown at seeding rate of 3 kg/faddan on November 17th and 22nd in the first and second seasons, respectively. Nitrogen fertilizer was added as ammonium nitrate (33.5% N) in two equal doses before the 1st and 2nd irrigation. Zinc foliar application (0.2% $ZnSO_4$ $7H_2O$) solution was sprayed on plants for one foliar application (rosette stage) or two foliar applications (rosette and bud stages). Normal cultural practices of growing canola were conducted in the usual manner by the farmers of this district. Canola plants were manually harvested on May 10th and 20th in the first and second season, respectively. At harvest, ten plants were taken randomly from the center of the plot to measure, plant height, number of siliqua/plant, number of seeds/siliqua, 1000-seed weight (g), seed yield/plant (g), seed yield/faddan and oil yield/faddan. Seed oil content was analyzed according to A.O.A.C. (1980) with Soxhelt. Data were subjected to statistical analysis of variance as described by Snedecor and Cochran (1990).

Results and Discussion

Effect of the main factors

Data presented in Table (1) show the effect of varietal differences on some yield and yield attributes. There were no significant differences between both varieties on the studied characters, except, plant height and seed yield/faddan where, Pactol surpassed in plant height and seed yield/faddan. These results are similar with those obtained by El Kholy et al. (2007).

The data presented in Table (1) show the effect of nitrogen fertilizer levels on some yield and yield attributes, increasing nitrogen fertilizer from 20 to 60 kg N/faddan significantly increased plant height, number of siliqua/plant, seed yield/plant, seed yield/faddan and oil yield/faddan while, seed oil content decreased by increasing nitrogen fertilizer. These results are in harmony with Mekki (2003).

Data presented in Table (1) show that yield and yield attributes were significantly increased by increasing number of zinc foliar applications where, plant height, number of siliqua/plant, number of seed/siliqua seed yield/plant, seed yield/faddan and oil yield/faddan were significantly affected.

Table (1) : Effect of varietal differences , nitrogen fertilizer levels and number of zinc foliar application on yield and yield attributes of canola plants (combined data of 2005-2006 and 2006-2007 seasons)

	Plant height (cm)	No. of siliqua /plant	No. of seed /siliqua	1000-seed weight (g)	Seed yield (g /plant)	Seed yield (kg/faddan)	Seed oil content (%)	Oil yield (kg/faddan)
Topas	122.68	140.64	11.59	3.41	5.56	769.67	40.60	312.37
Pactol	124.20	140.66	11.11	3.55	5.54	784.78	40.31	316.36
LSD 5%	1.42	NS	NS	NS	NS	6.44	NS	NS
20 kg N/fad.	115.37	129.98	11.28	3.37	4.94	722.51	40.93	295.50
40 kg N/fad.	124.45	139.40	11.55	3.49	5.62	762.89	40.35	307.40
60 kg N/fad.	130.49	152.59	11.21	3.57	6.08	846.27	40.09	339.51
LSD 5%	1.36	1.93	NS	NS	0.13	5.58	NS	6.09
One zinc appli.	122.54	138.04	11.59	3.43	5.48	765.73	40.50	309.91
Two zinc appli.	124.33	143.26	11.11	3.53	5.61	788.71	40.41	318.81
LSD 5%	1.11	1.58	0.27	NS	0.11	4.55	NS	4.97

Fad = faddan (4200 m^2)   appli = application

Effect of the interactions

Data in Table (2 A) show the effect of the interaction between varietal differences and nitrogen fertilizer levels, with significant differences between both factors on the studied characters except seed oil content. Addition of 60 kg N/faddan to both varieties (Topas and Pactol) did not show significant differences in the most studied characters except number of siliqua/plant, where an addition of 60 kg N/faddan to Topas recorded the highest number of siliqua/plant. Increasing nitrogen levels from 20 to 60 kg N/faddan with both varieties deceased seed oil content while, oil yield/faddan increased with no significant differences between both varieties in this character.

Data in Table (2 B) show the effect of the interaction between varietal differences and number of zinc foliar application. No significant differences were observed on the studied characters except the number of siliqua/plant, seed yield/faddan and oil yield/faddan, where, Pactol with two zinc foliar application surpassed in plant height, number of siliqua/plant, 1000-seed weight, seed yield/faddan and oil yield/faddan.

Data in Table (2 C) show the effect of the interaction between nitrogen fertilizer levels and the number of zinc foliar application, where significant differences between both factors on the studied characters except the number of seed/siliqua, 1000-seed weight and seed oil content. Increasing number of zinc foliar application with either 20 or 40 kg N/faddan did no show significant differences in plant height and seed yield/plant.

The effect of the third order interaction between the studied treatments show significant differences in plant height, number of siliqua/plant, seed yield and oil yield. Two zinc foliar application + 60 kg N/faddan with both varieties did not show significant differences in the studied characters.

Table (2 A) : Effect of interaction between varitial differences and nitrogen fertilizer levels on yield and yield attributes of canola plants (combined data of 2005-2006 and 2006-2007 seasons)

		Plant height (cm)	No. of siliqua /plant	No. of seed /siliqua	1000-seed weight (g)	Seed yield (g /plant)	Seed yield (kg/faddan)	Seed oil content (%)	Oil yield (kg/faddan)
Topas	20 kg N/fad.	114.99	128.29	11.59	3.32	4.94	718.18	40.88	293.59
	40 kg N/fad.	122.54	138.42	12.06	3.39	5.66	747.73	40.61	303.66
	60 kg N/fad.	130.51	155.24	11.13	3.52	6.07	843.10	40.31	339.86
Pactol	20 kg N/fad.	115.74	131.67	10.98	3.43	4.94	726.84	40.99	297.92
	40 kg N/fad.	126.37	140.37	11.07	3.60	5.58	778.05	40.08	311.94
	60 kg N/fad.	130.47	149.94	11.29	3.62	6.09	849.44	39.86	339.34
LSD 5%		1.92	2.73	0.46	0.07	0.52	7.89	NS	4.32

Table (2 B) : Effect of interaction between varietal differences and number of zinc applications on yield and yield and yield attributes of canola plants (combined data of 2005-2006 and 2006-2007 seasons)

Topas	One zinc appli.	121.80	138.72	11.77	3.36	5.49	760.63	40.68	309.57
	Two zinc appli.	123.56	142.58	11.39	3.46	5.62	778.71	40.52	315.46
Pactol	One zinc appli.	123.29	137.37	11.37	3.50	5.47	770.84	40.32	310.55
	Two zinc appli.	125.11	143.95	10.83	3.59	5.60	798.72	40.30	322.18
LSD 5%		NS	1.06	NS	NS	NS	6.44	NS	3.02

Table (2 C) : Effect of interaction between nitrogen fertilizer levels and number of zinc application on yield and yield attributes of canola plants (combined data of 2005-2006 and 2006-2007 seasons)

20 kg N/fad.	One zinc appli.	115.06	128.11	11.59	3.30	4.90	709.99	41.01	291.09
	Two zinc appli.	115.67	131.85	10.95	3.44	4.97	735.03	40.86	299.89
40 kg N/fad.	One zinc appli.	124.06	137.06	11.64	3.47	5.54	751.14	40.31	302.70
	Two zinc appli.	124.85	141.74	11.44	3.52	5.71	774.64	40.38	312.95
60 kg N/fad.	One zinc appli.	128.50	148.97	11.47	3.51	6.00	836.07	40.17	335.79
	Two zinc appli.	132.48	156.21	10.88	3.62	6.16	856.47	40.01	343.41
LSD 5%		1.92	2.34	NS	NS	0.39	8.39	NS	5.68

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